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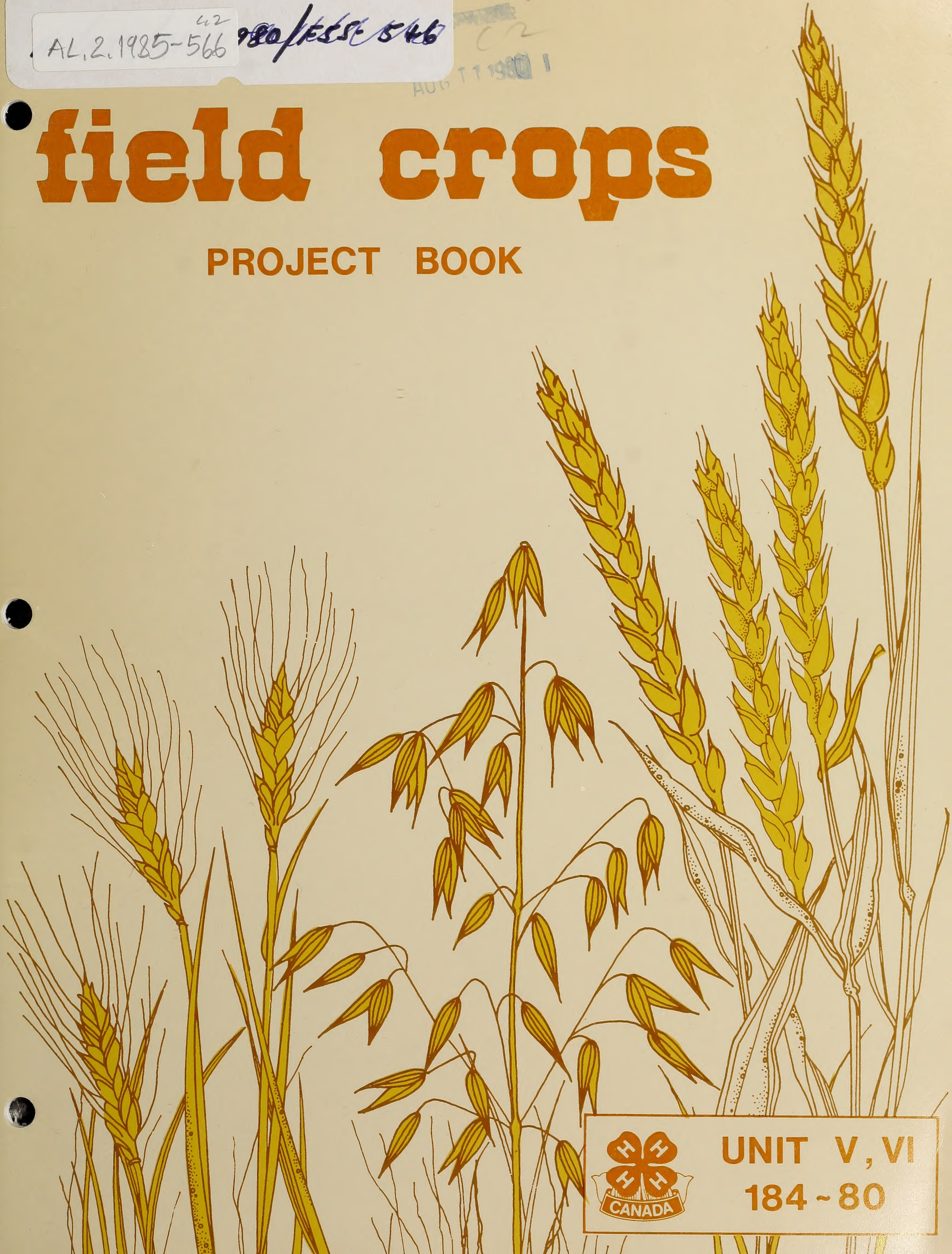
# field crops

## PROJECT BOOK



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## 4-H MOTTO

"Learn to do by doing"

## 4-H PLEDGE

I pledge
My HEAD to clearer thinking,
My HEART to greater loyalty,
My HANDS to larger service,
My HEALTH to better living,
For my club, my community and my country

## 4-H GRACE

(Tune of Auld Lang Syne)

We thank thee, Lord, for blessings great
On this, our own fair land.
Teach us to serve thee joyfully,
With head, heart, health and hand.

CANADA

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# SOILS AND FERTILIZERS

Believe it or not the crop rotation, tillage operations and amount and kind of fertilizer that you and your family use on your farm are related to the kind of soil you have, the amount of precipitation and sunshine your farm gets and the kind of vegetation that grows wild in your area. All of these are a direct result of your geographical location or where you live within the province of Alberta.

The major soil groups are depicted on the map on the following page taken from Alberta Soils Advisory Committee, Alberta Fertilizer Guide (1).

There is a very similar pattern in soil zones, climatic zones, vegetation zones, cropping practices, and fertilizer use that runs across our province from the Southeast to the Northwest.

## A. BROWN SOILS

Brown soils develop in the semi-arid, short grass prairie regions of the southeast part of the province. Rainfall here is less than 30 cm each year. A large majority of the land is in native range and where dry-land farming is possible, wheat-fallow rotations are followed because moisture is the most limiting factor to crop production. Where this type of rotation is followed, phosphorous is usually the nutrient that is most needed, but only low rates are profitable because of the lack of moisture.

## B. DARK BROWN SOILS

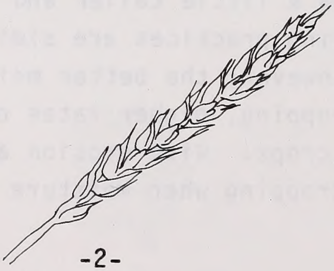
As you go west and north the soil becomes a darker brown, the prairie grasses grow a little taller and the rainfall averages 35 cm annually. Cropping practices are similar to those in the Brown Soil zones, however, the better moisture conditions allow frequent stubble cropping, higher rates of fertilization and a greater variety of crops. Wind erosion and soil salinity control may force stubble cropping when moisture levels are low.

## C. THIN BLACK SOILS

Still further west and north, in this soil zone, soil moisture reserves and summer precipitation greatly affect yield and response to fertilizer. Rainfall is higher here than in those regions to the south and east and the native grasses grow tall. Groves of aspen poplar begin to appear everywhere as you travel from the southern and eastern parts to the western and northern parts. Because rainfall is quite variable, increased production can be realized from adjusting crop rotations and fertilizer rates to the soil moisture reserves. Cropping frequency here becomes extended to crop-fallow rotations or to continuous cropping. Under these cropping practices nitrogen becomes an increasingly deficient nutrient.

## D. BLACK AND DARK GREY SOILS (CENTRAL ALBERTA)

Here there is little need for fallowing to store soil moisture as rainfall is higher than in those areas to the south and east. Park-like groves of aspen poplar are common in this soil zone as moisture permits tree growth. Good crop yield under continuous cropping can be maintained with the use of relatively high rates of nitrogen fertilizer, but rotations that include grasses and legumes and the application of manure are recommended to help maintain soil tilth and soil organic matter. Management practices here are geared to high yields. Often the relationship between fertilizer cost and crop prices will determine returns. Although continuous cropping requires greater fertilizer input, this does not mean that it is more harmful than crop-fallow rotation. In fact, the opposite is frequently true. Fallowing can lead to rapid loss of organic matter, expose the soil to wind and water erosion and on some soils contribute to increased soil salinity. Fallowing should only be practised when soil moisture reserves are too low to grow an acceptable crop.



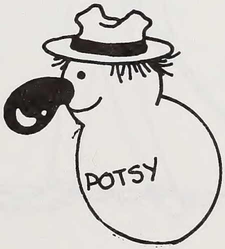
## E. GREY WOODED SOILS (CENTRAL ALBERTA)

These soils were developed under cool, humid conditions and usually under tree growth. The surface layer is leached of clay and plant nutrients leaving these soils low in initial fertility and organic matter. Soil crusting often reduces seedling emergence. Crop rotations that include legumes and grasses increase soil organic matter, fertility, and reduce "crusting". Nitrogen is often the limiting factor to high crop yields as moisture is not as limiting here as in other portions of Alberta. Many of these soils are deficient in sulphur and use of a sulphur-containing fertilizer on cereal and rapeseed is advised where a soil is known to show a response to sulphur, on legume crops, or where a deficiency is indicated by a soil test.

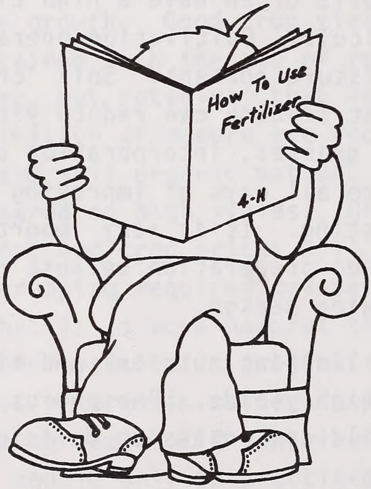
## F. DARK GREY AND GREY WOODED SOILS (NORTH EASTERN ALBERTA)

These soils are similar to those in Central Alberta, but generally receive less rainfall in the growing season. In the Peace region these soils often have a high clay content, making management more difficult. Cultivation operations must be timed according to soil moisture content. Soil "crusting" and poor moisture conditions at seeding can reduce yields. Crop rotations including legumes or grasses, incorporation of crop residues, and addition of manure are all ways of improving soil tilth and reducing surface crusting. It is very important to conserve moisture during seedbed preparation because rainfall is often low during the early growing season.

Nitrogen is the most limiting nutrient and high inputs are required to produce high yields. Phosphorus and sulphur are also deficient on many soils and potassium deficiency does occur on some soils.



Available phosphorus levels in all Alberta soils are often in the deficient range. However, unlike nitrogen they do not change quickly or in great amounts as a result of cropping, soil management or climate. Rates of phosphorus application should depend on the available phosphorus in a particular field soil, the requirements of the crop to be grown and general growing conditions. Two nutrients not commonly deficient in Alberta soils are potassium and sulphur, but deficiencies do occur in some soil types.



# SPECIAL OR PROBLEM SOILS

## A. IRRIGATED SOILS

Under irrigation, rainfall does not limit crop yields. Here, crops are limited more by soil fertility than anything else. It is possible to obtain high yields with very large amounts of barn manure (about 50.3 tonnes) per hectare per year, but supplies are generally limited. Most crops under irrigation respond to nitrogen and phosphorous fertilizers. One can add nitrogen to the soil by plowing under a legume crop. Plowing under a non-legume crop for green manure does not add any plant nutrients but will improve the soil tilth (physical condition).

## B. SOLONETZIC SOILS

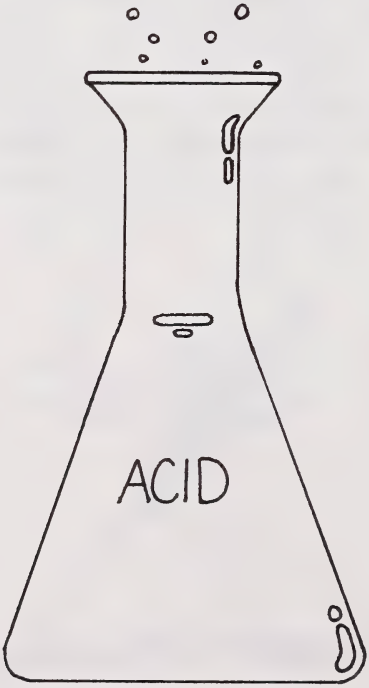
These soils have a hard-pan layer 5 to 25 cm from the surface. They occur in pockets among normal soils and often cause a typical uneven pattern of crop growth. These soils restrict rooting depth particularly in years of moisture stress. As a result response to fertilizers is more variable. Therefore nitrogen fertilization rates should be reduced on these soils. Drilled applications are often more effective than broadcast.

## C. ACID SOILS

Acid soils are easily identified by a soil test showing a low pH. The soil reaction is alkaline when the pH is above 7, neutral at 7, and acid below 7. Yields of alfalfa are reduced at a pH of 6.0 and less and barley at 5.5 and less. Crops vary greatly in tolerance to acidity. Annual crops in decreasing order of tolerance are oats, flax, rapeseed, wheat and barley. Alfalfa and sweet clover are very sensitive to acidity while timothy, fescue, red clover and alsike clover are some of the more tolerant forages.

Acid soils occur naturally and also as a result of long term use of nitrogen fertilizers. Ammonium sulfate (21-0-0) has the greatest acidifying properties compared to other nitrogen sources and its extensive use is not recommended.

Liming is a common practice in many parts of the world to neutralize acidity. Growing acid tolerant crops can improve yields on moderately acid soils but the only long term solution is the application of lime.

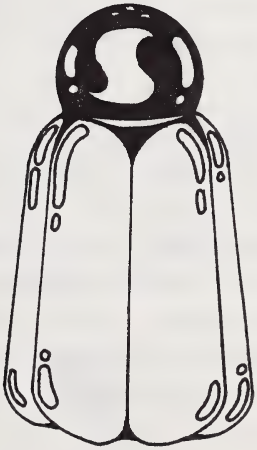


## D. SALINE SOILS

Saline soils often called white alkali soils, contain a high concentration of salts. This results from excess water (from irrigation, precipitation, sloughs or large ponds) which moves below the rooting zones collecting salts. When the water meets a layer that is impermeable, it moves horizontally until soil capillary flow causes upward movement and the salts are discharged on the soil surface.

You can prevent saline areas from developing by enpuring that excess moisture is not allowed to collect in the recharge area. This may involve surface draining or more intensive cropping. Alfalfa is a good high moisture crop and will dry the soil to a depth of 4.5 to 7.5 meters.

Any recropping or perennial cropping requires the use of salt tolerant varieties. Proper soil tests help to identify the problem, select fertilizers and choose crop varieties.



# FERTILIZERS

## A. NITROGEN

Nitrogen has the ability to move in moist soil and, therefore, need not be applied near the seed. However, if the seedbed remains dry during the early growing season, surface application can result in reduced uptake. Nitrogen, if applied in a band at a depth of 10-15 cm, as in the case of anhydrous ammonia application, or if drilled in with the seed, may be more effective when the surface soil remains dry. Too much nitrogen drilled with the seed can reduce germination. The amount that can be safely drilled with the seed varies with the crop grown, the soil texture, moisture conditions and the type of nitrogen fertilizer you use.

According to the Alberta Soils Advisory Committee(1), the following ranges can occur in the amount of nitrogen that can be safely drilled in with the seed.

Wheat - 22 to 44 kg/hectare
Oats of Barley - 16 to 28 kg/hectare
Small Seeded crops
(Rapeseed, mustard, flax and cereals underseeded with a legume that is placed in the drill row.) - No more than 11 kg/hectare

Nitrogen fertilizers can be applied in either spring or fall. However, under dry conditions nitrogen applied in the fall can be more effective because it has more time to move deeper into the root zone. Fall applications are not recommended on poorly drained sites where soil remains saturated or flooded for long periods in the spring because significant losses of nitrogen can occur under these conditions through a process called denitrification. Soil temperatures should be below 10°C before nitrogen is applied in the fall.

Top dressing of nitrogen on cereals after emergence can be effective up to the shot-blade stage. It should be considered when severe nitrogen deficiency symptoms appear early in the growing season.

## B. PHOSPHORUS

Since phosphorus fertilizer does not move readily in the soil, it must be placed near the seedling roots to get the best results. Phosphate fertilizers should be drilled with or near the seed for annual crops. Broadcast application may cause a delay in response due to the slow movement of phosphorus. Thus, where this method is used, as on established forages, a greater response may be evident in the year following application than in the year of application. Phosphate fertilizer should be worked into the soil prior to seeding perennial forages on soil very deficient in phosphorus.

## C. POTASSIUM

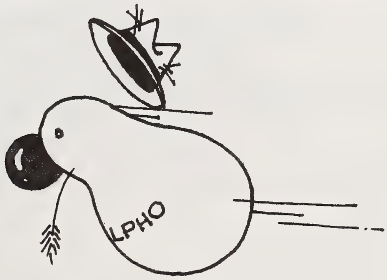
Potassium will move in soil more readily than phosphorus, but for annual crops better results are obtained from applications drilled with or near the seed. According to the Alberta Soils Advisory Committee (1), the maximum amount which may be safely placed with the seed is 33 kg/hectare for small seeded crops such as rapeseed or flax.

Broadcast applications can be used in either spring or fall at about twice the rate used for applications which are drilled into the soil.

## D. SULPHUR

Sulphur moves readily in moist soils when in the sulphate ($SO_4$) form. Therefore, soluble sulphate fertilizers provide good results either as broadcast or drilled-in applications.

Elemental sulphur ($S_2$) and gypsum (which contains sulphur) can also be used as sulphur fertilizers.



# NUTRIENTS

## A. NITROGEN FERTILIZER SOURCES:

1. **AMMONIUM NITRATE** (34-0-0):
   - contains nitrogen in both the ammonium and nitrate form.
   - less subject to volatilization losses than urea when surface applied without incorporation.
   - more subject to leaching losses on sandy soils.
   - used with ammonium phosphate to make the common fertilizer grades 23-23-0 and 26-13-0.

2. **AMMONIUM SULPHATE** (21-0-0-24S):
   - 24% sulphur.
   - used for direct application as both a nitrogen and sulphur source.
   - used with ammonium phosphate to make 16-20-0.
   - more acidifying than other nitrogen fertilizers and therefore, should not be used continuously on acid soils.

3. **UREA** (46-0-0):
   - highest analysis dry nitrogen fertilizer.
   - used for direct application or combines with phosphate to make 27-27-0.
   - more subject to volatilization losses when not incorporated into the soil. Significant losses can occur when urea is applied under warm, dry conditions to sandy soils, forages with a heavy thatch and on alkaline soils (pH 7.5 or higher).

4. **ANHYDROUS AMMONIA** (82-0-0):
   - highest analysis nitrogen fertilizer.
   - suitable for fall or spring application for annual crops.
   - a narrow shank applicator with 40 cm spacing is commonly used to inject ammonia at a depth of 10 to 15 cm. The soil must be worked sufficiently to close behind the application shank to prevent escape of the ammonia gas.

**Caution**: Anhydrous ammonia is a pressurized gas. Everyone involved in the handling and use of ammonia should be aware of their role in keeping ammonia safe. For further information see:

> Anhydrous Ammonia as a Fertilizer - Pub. No. 540-1.
> Agriculture Ammonia Safety, The Fertilizer Institute, 1015 - 18 Avenue, Washington, D.C. 20036.

5. **UREA - AMMONIUM SULPHATE** (34-0-0-11S):
   - contains 11% sulphur.
   - supplies adequate sulphur when used as the nitrogen source on sulphur deficient soils.

6. **UREA - AMMONIUM NITRATE SOLUTIONS** (28-0-0 and 32-0-0):
   - not recommended as a spray application to forage crops.
   - losses from volatilization and immobilization may occur if sprayed on to heavy trash cover.
   - solutions lend themselves to uniform application and ease of handling.

7. **UREA - AMMONIUM SULPHATE SOLUTION** (20-0-0-5S):
   - contains 5% sulphur and will supply adequate sulphur when used as the nitrogen source on sulphur deficient soils.
   - comments under No. 6 also apply to 20-0-0-5S.

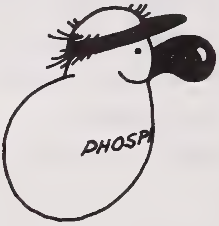
## B. PHOSPHORUS FERTILIZER SOURCES:

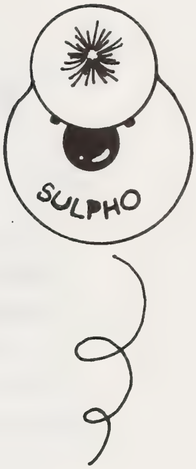
1. **MONOAMMONIUM PHOSPHATE** (11-48-0, 11-54-0 and 11-55-0):
   - the most common phosphate fertilizers available in Alberta.
   - used for drill-in application on annual crops, broadcast application on perennial forage or blended with nitrogen fertilizers to give various nitrogen-phosphate fertilizers such as 16-20-0, 23-23-0, 27-27-0 and 26-13-0.

2. **DIAMMONIUM PHOSPHATE** (18-46-0):
   - used to a limited extent as a drill-in application for cereal crops on fallow in place of 11-48-0 or 11-55-0 where more nitrogen is required.
   - there is some evidence indicating that diammonium phosphate is slightly less efficient than monammonium phosphate on calcareous soils (soils containing free lime).

## C. POTASSIUM FERTILIZER SOURCES:

1. **MURIATE OF POTASH** (0-0-60 or 0-0-62):
   - most commonly available potassium fertilizer in Alberta.
   - used directly as a broadcast application or mixed with phosphorus and nitrogen fertilizers to make fertilizer grades such as 10-30-10, 8-24-24, 13-13-13, etc. NOTE - the cost of potash in some of the complete fertilizers tends to be considerably higher in 0-0-60 or 0-0-62. Therefore, prices should be compared on the basis of the cost per unit of nutrient.





## D. SULPHUR FERTILIZER SOURCES:

1. **AMMONIUM SULPHATE** (21-0-0-24S):
   - contains 24% sulphate sulphur.
   - used directly as both a nitrogen and sulphur source or combined with ammonium phosphate to produce 16-20-14S or with urea to produce 34-0-0-11S.

2. **UREA - AMMONIUM SULPHATE** (34-0-0-11S):
   - contains 11% sulphur.
   - not as acidifying as ammonium sulphate and, therefore, preferable for use on acid soils that are sulphur deficient.

3. **AMMONIUM PHOSPHATE-SULPHUR** (16-20-0-14S):
   - made from monoammonium phosphate and ammonium sulphate.
   - common source of nitrogen, phosphorus, and sulphur for broadcast and drill-in application.

4. **UREA - AMMONIUM SULPHATE SOLUTION** (20-0-0-5S):
   - see comments for 34-0-0-11S, 28-0-0 and 32-0-0 solutions.

5. **ELEMENTAL SULPHUR** (AGRI SUL - 90% S):
   - a granular elemental sulphur fertilizer that can be used directly as a broadcast application or blended with other fertilizers except ammonium nitrate.
   - elemental sulphur must be converted to sulphate sulphur before it is available to plants. Therefore, it will not be available as quickly as a soluble sulphate fertilizer such as ammonium sulphate but will have a longer residual effect.

6. **GYPSUM** ($CaSO_4 \cdot 2H_2O$)
   - contains 18% sulphur in the sulphate form, but is not as soluble as ammonium sulphate.
   - supplies both calcium and sulphur.

# FERTILIZERS FOR YOUR CROP

According to the Alberta Soils Advisory Committee (1), the following three things are needed to determine fertilizer requirements:

1. Identification of the nutrient or nutrients that are deficient and the degree of deficiency.
2. Estimation of crop response to a given level of fertilization.
3. Assessment of economic returns from fertilizer.

We will discuss these topics in relation to each of the four major nutrients: nitrogen, phosphorus, potassium and sulphur.

## A. NITROGEN

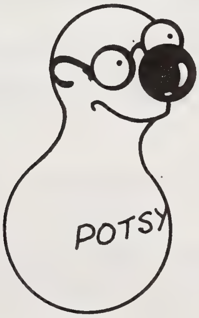
There is a wide range of application rates of nitrogen for optimum economic returns on crops grown across Alberta. For example, crops grown on fallow often require little or no additional nitrogen, while non-legume crops such as wheat grown on stubble can give profitable returns to application rates of 100 kg/hectare or more of nitrogen. The main reason for this difference is the large differences in the amount of nitrogen that the soil can supply and the potential yield of the crop allowed by moisture conditions.

Non-legume crops obtain nitrogen from three main sources: available nitrogen stored in the soil, nitrogen released by the soil organic matter during the growing season, and fertilizers. Legume crops, of course, can "fix" nitrogen from the atmosphere. Because our growing season is relatively short, only about 1/4 of the total nitrogen needed for high yields is supplied by that which is released from soil organic matter during the growing season. In most cases fallow fields store enough available nitrogen in the soil to give high yields. Stubble fields do not.

The best way of accurately determining available nitrogen in the soil is to test a representative sample taken before seeding. Past experience, the cropping history and general recommendations are useful guides, but wide variations do occur from year to year which can only be detected by a soil test.

When estimating the increase in crop yield from a given rate of nitrogen fertilizer, we must consider: available soil nitrogen at planting, soil moisture reserves and the expected growing season precipitation (especially in the Brown, Dark Brown and Thin Black Soil Zones), competition from weeds, timing of seeding and the crop variety. Weed competition lowers the yield potential of the crop and competes for the nitrogen fertilizer. Delayed or late seeding also results in a lower yield potential of the crop and a greater risk of crop loss from frost and poor harvest conditions thus causing the lower increase in crop response to the nitrogen fertilizers. Varieties with higher yield potential will generally respond to higher rates of nitrogen fertilization providing other factors are not limiting.

The Agriculture Soil and Feed Testing Laboratory provides predictions of the increase in yield from applied nitrogen based on the test for available nitrogen, the soil type, location, the previous crop, and the crop to be grown. You can then use these predictions combined with your own past experience, current moisture reserves, seeding date, etc. to determine the rate of fertilizer to apply.



## B. PHOSPHORUS

The rate of phosphorus fertilization required according to the Alberta Soils Advisory Committee, depends on the available phosphorus level of the field, the phosphorus requirement of the crop to be grown, and the growing conditions. Available phosphorus levels in a specific field do not vary widely from one year to another, but tend to be characteristic of the soil type. Requirements tend to be higher for irrigated crops and higher for crops grown in central and northern Alberta than in southern Alberta. Response to phosphorus is greater when cool wet conditions prevail early in the growing season. Another reason why phosphorus fertilization is generally higher in central and northern regions is because it promotes earlier, more uniform maturity.

Adjustment in the rate of phosphorus application should be made similar to those of nitrogen, however, they should be proportionately smaller. For example, a 20-30 kg change in the rate of nitrogen means that there should only be a 10-15 kg change in the rate of phosphate. One should also note in contrast to nitrogen, even though a field may test high in available phosphorus, an economic return will be obtained from this minimum rate of phosphorus application.

## C. POTASSIUM

For the most part, Alberta soils are not deficient in potassium, but deficiencies do occur in certain areas and soil types. These soils occur most frequently in west central, northwestern (excluding the Peace Region) and northeastern Alberta.

Potatoes have a very high potassium requirement and may require additional potassium even on soil containing adequate amounts for other crops.

Potassium is a relatively inexpensive, but important fertilizer nutrient. If potassium is tried on a test strip, yields should be carefully measured rather than visually estimated. Also adequate rates of nitrogen and phosphorus should be applied on the two areas to be compared.

## D. SULPHUR

Some Grey Wooded and Dark Grey Wooded soils as well as some Sandy Black soils are deficient in sulphur. Sulphur deficiencies seldom occur in crops grown on fallow land, but legume, cereal and oilseed crops that are well fertilized with nitrogen and phosphorus often require sulphur as well.

Sulphur fertilization is relatively inexpensive because of the low rate of application (11-22 kg/hectare and the low cost of the nutrient). High returns are usually received when adequate sulphur is supplied on deficient soils.

The most effective way of determining a deficiency of any nutrient is through a soil test.

# RETURNS FROM FERTILIZERS

When using the same estimates of increase in yield from fertilizer "net returns" or the value of the increased yield minus the cost of the fertilizer were higher in 1975 than in 1970 (following table). Why? The reason is, of course, because of the crop and fertilizer price relationship. In 1970 net returns were higher for rapeseed than for wheat, barley or oats, but in 1975 net returns were similar for all four crops. Why? Because of the relationship between the prices of the different crops.

Comparing returns based on present and past fertilizer and crop prices can be a useful tool when choosing your fertilizer program. The following table converted from Alberta Soils Advisory Committee, Alberta Fertilizer Guide shows such comparisons at two different levels of fertilization.

## EFFECT OF FERTILIZER AND CROP PRICES ON RETURNS FROM FERTILIZER

| CROP | PRICE PER TONNE | INCREASED IN YIELD FROM FERTILIZER | | VALUE OF INCREASED YIELD | | FERTILIZER COST | | NET RETURNS | | MARGINAL COSTS | MARGINAL RETURNS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | | |
| | | tonnes/ha | | | | | | | | | |
| **Wheat** | | | | | | | | | | | |
| 1970 | $47.77 | 0.693 | 0.935 | $33.09 | $44.65 | $15.79 | $21.19 | $17.30 | $23.46 | $5.38 | $11.56 |
| 1975 | $128.60 | | | $89.12 | $120.24 | $26.60 | $35.56 | $62.52 | $84.68 | $8.96 | $31.12 |
| **Barley** | | | | | | | | | | | |
| 1970 | $36.74 | 0.931 | 1.205 | $34.20 | $44.28 | $15.79 | $21.19 | $18.41 | $23.09 | $5.38 | $10.07 |
| 1975 | $91.86 | | | $85.52 | $110.69 | $26.60 | $35.56 | $58.92 | $75.13 | $8.96 | $25.17 |
| **Oats** | | | | | | | | | | | |
| 1970 | $32.42 | 0.941 | 1.219 | $30.51 | $39.54 | $15.79 | $21.19 | $14.72 | $18.35 | $5.38 | $9.01 |
| 1975 | $90.78 | | | $85.42 | $110.66 | $26.60 | $35.56 | $58.82 | $75.10 | $8.96 | $25.24 |
| **Rapeseed** | | | | | | | | | | | |
| 1970 | $121.25 | 0.381 | 0.515 | $46.20 | $62.44 | $15.79 | $21.19 | $30.41 | $41.25 | $5.38 | $16.25 |
| 1975 | $220.46 | | | $83.99 | $113.54 | $26.60 | $35.56 | $57.39 | $77.98 | $8.96 | $29.54 |

Fertilizer prices used: 1970 - Nitrogen $.24/kg Phosphate $.18/kg
1975 - Nitrogen .40/kg Phosphate .31/kg

1* - 44.8 kg/ha of nitrogen and 28 kg/ha of phosphate
2* - 67.2 kg/ha of nitrogen and 28 kg/ha of phosphate

The best method of selecting a fertilizer rate is to compare "marginal costs" and "marginal returns" over a range of application rates. Marginal cost is the cost of the additional fertilizer. In Table 1 (next page), the marginal or additional cost is the cost of 22.4 kg/hectare of nitrogen (or the cost of the difference in fertilizer rates, 67 kg/ha compared to 45 kg/ha). The marginal cost, of course, is different in each year because of the difference in cost of fertilizer.

Marginal return is the value of the increase in yield from the additional fertilizer. For example: for wheat in 1970, the value of the increased yield was:

0.935 tonnes - 0.693 tonnes = 0.242 tonnes
0.242 tonnes X $47.77/tonne = $11.56/hectare

The marginal cost in 1970 for wheat was 22.4 kg X $.24/kg = $5.38/hectare. So in this case the marginal return was twice the marginal cost.

If you add additional fertilizer beyond the point where marginal costs equal marginal returns, it will cost more than the value of the increased yield. Maximum net returns per hectare can be achieved when marginal costs equal marginal return, however, because of the risks involved in crop production and in price uncertainties, it may be wise to choose a lower level of fertilization. Another thing to consider if you are short of operating capital (money) is that additional dollars spent on fertilizer may return you less than if the money were spent on other production inputs such as weed control.

# SOURCES

1. Alberta Soil Advisory Committee, Alberta Fertilizer Guide, Agdex 541-1, published by Alberta Agriculture, 1976.

For further information on any of these topics, see you local District Agriculturalist.

Special thanks to 4-H Regional Specialists Brian Matthiessen (Red Deer) and Milo Barffus (Lethbridge) for co-operating with the development of this Field Crop Series.

# PROJECT EVALUATION

In order to keep meeting your needs in the 4-H program, we would like to request your assistance in completing this evaluation form. Make your suggestions on this sheet as you use this book. After the project has been completed, mail this form to:

Project Evaluation
4-H Branch
Alberta Agriculture
9718 - 107 Street
Edmonton, Alberta
T5K 2C8

(use another page if required)

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